BIW

F.W. BELL
An Allegheny International Company
6120 HANGING MOSS ROAD
ORLANDO FL 32807-3701

MAINTENANCE / SERVICE
MODEL CG-100D GUN PLUS

F.W. BELL, INC.
6120 HANGING MOSS RD.
ORLANDO, FL 32807
PH. (305) 678-6900
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UN-01-132

GUN PLUS MAINTENANCE / SERVICE

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN CONTAINED IN THE OPERATING INSTRUCTIONS.

I. INTRODUCTION:

A. Included in this section are procedures for battery installation, calibration, and troubleshooting. General maintenance of the Gun includes periodic cleaning and inspection. To clean, wipe the unit with a damp cloth, make sure the core and aperture are kept free from dirt and foreign substances.

II. BATTERY INSTALLATION:

A. CAUTION: If the Gun is not to be used for an extended period, it is recommended that the batteries be removed to protect the unit.

B. There are four "AA" alkaline batteries that supply 6V operating power to the Gun (See Figure 1). A "Battery Low" indicator, located on the Liquid Crystal Display (LCD), will appear when the batteries require replacement.

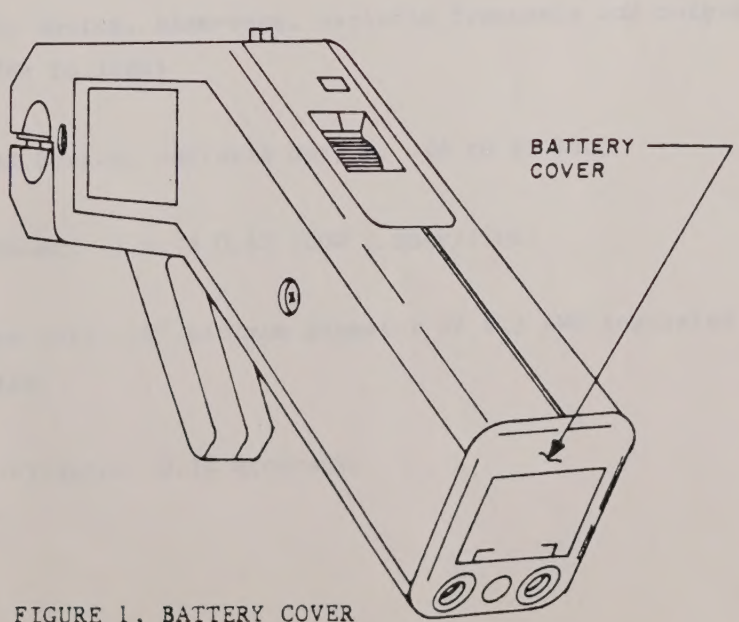



FIGURE 1, BATTERY COVER

III. CALIBRATION:

A. Complete calibration of the F.W. Bell, Inc. Current Gun Plus is accomplished by adjustment of 3 trimming potentiometers. These potentiometers are accessible, without disassembly, through holes in the plastic case located under Model/Logo Label, as shown in the diagram, Figure #3.

B. DESCRIPTION OF ADJUSTMENTS:

1. Coarse Zero adjustment to null-out initial dc voltage offsets and to set the null at the center of travel of the zero adjustment thumbwheel.

2. Output Calibration adjustment sets the sensitivity of the output amplifier so that the output voltage falls within the specified accuracy. The output sensitivity is 1.0V for 100A.

3. Read-out Calibration adjustment sets the 3½ digital meter of the Gun to agree with the output reading.

C. EQUIPMENT REQUIRED:

1. AC Current Source, sine-wave, variable frequency and output. (0.10: 50Hz to 1kHz)

2. DC Current Source, variable output. (0 to 10 Adc)

3. Current Shunt, 0.5Ω ± 0.1% 100W (.500V/1.0A)

4. Fifty-turn coil, 18" minimum diameter of #15 AWG insulated magnet wire.

5. Digital voltmeter. 0.1% accuracy.

D. EQUIPMENT SET-UP:

See Figure 2.

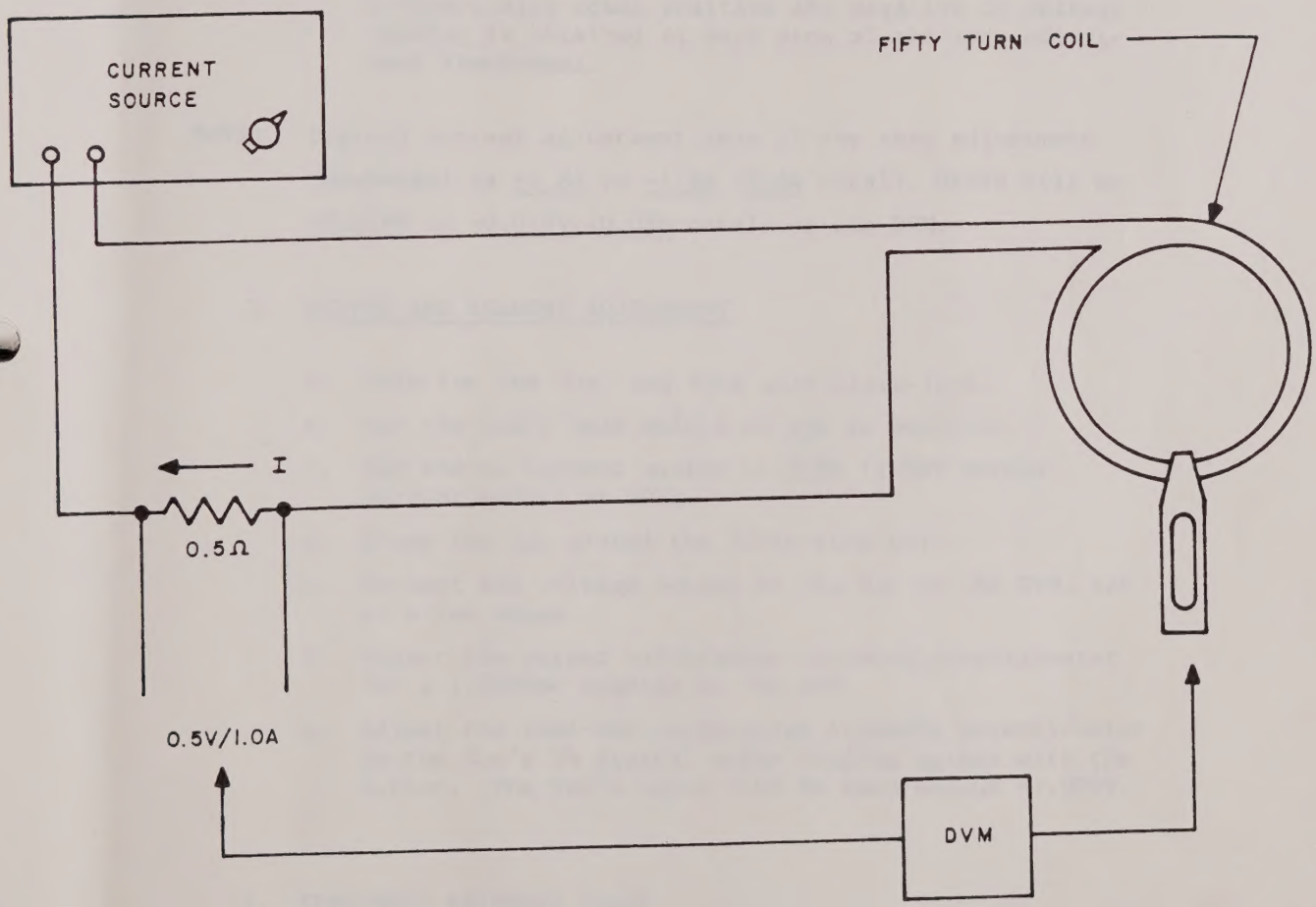



FIGURE 2, EQUIPMENT SET-UP

E. STEP BY STEP ADJUSTMENT PROCEDURE (FOR ADJUSTMENT LOCATION, SEE FIGURE #3).

1. COARSE DC ZERO ADJUSTMENT

a. Turn the Gun "on" and lock with slide-lock.

b. Set the Gun's mode switch to the dc position.

c. Connect the Gun's output to the DVM, set to a low dc voltage range.

d. Adjust the coarse zero trimming potentiometer until a numerically equal positive and negative dc voltage reading is obtained at each stop of the zero adjustment thumbwheel.

NOTE: Typical current adjustment span of the zero adjustment thumbwheel is +1.8A to -1.8A (3.6A total), which will be +0.018V to -0.018V (0.036 total) on the DVM.

2. OUTPUT AND READOUT ADJUSTMENT

a. Turn the Gun "on" and lock with slide-lock.

b. Set the Gun's mode switch to the ac position.

c. Set the ac current source to 2.0A (1.00V across current shunt) at 50Hz.

d. Clamp the Gun around the fifty-turn coil.

e. Connect the voltage output of the Gun to the DVM, set to a low range.

f. Adjust the output calibration trimming potentiometer for a 1.000Vac reading on the DVM.

g. Adjust the read-out calibration trimming potentiometer so the Gun's 3½ digital meter reading agrees with the output. The Gun's meter =100.0A when output =1.000V.

3. FREQUENCY RESPONSE CHECK

a. Set the Gun mode switch to the ac position.

b. Clamp the Gun around the fifty-turn-coil.

c. Set the ac current source to 2.0A (same as above), 1kHz.

d. The Gun's meter reading should be 99.5 to 102, 100.4 typical.

e. Set the ac current source to 8.0A (same as above), 400kHz.

f. The Gun's meter reading should be 391 to 397, 394A typical.

4. DC CALIBRATION CHECK

a. Set the dc current source to 2A (1.000V across current shunt).
b. Set the Gun's mode switch to the dc position.
c. Remove the Gun from the coil.
d. Turn "off" and "on" to stabilize the core.
e. Clamp the Gun on the fifty-turn coil.
f. Note the readings of the output and the meter of the Gun, the errors of both should be less than ±1.0A (1.0%). Typically the output error is ±0.5A.

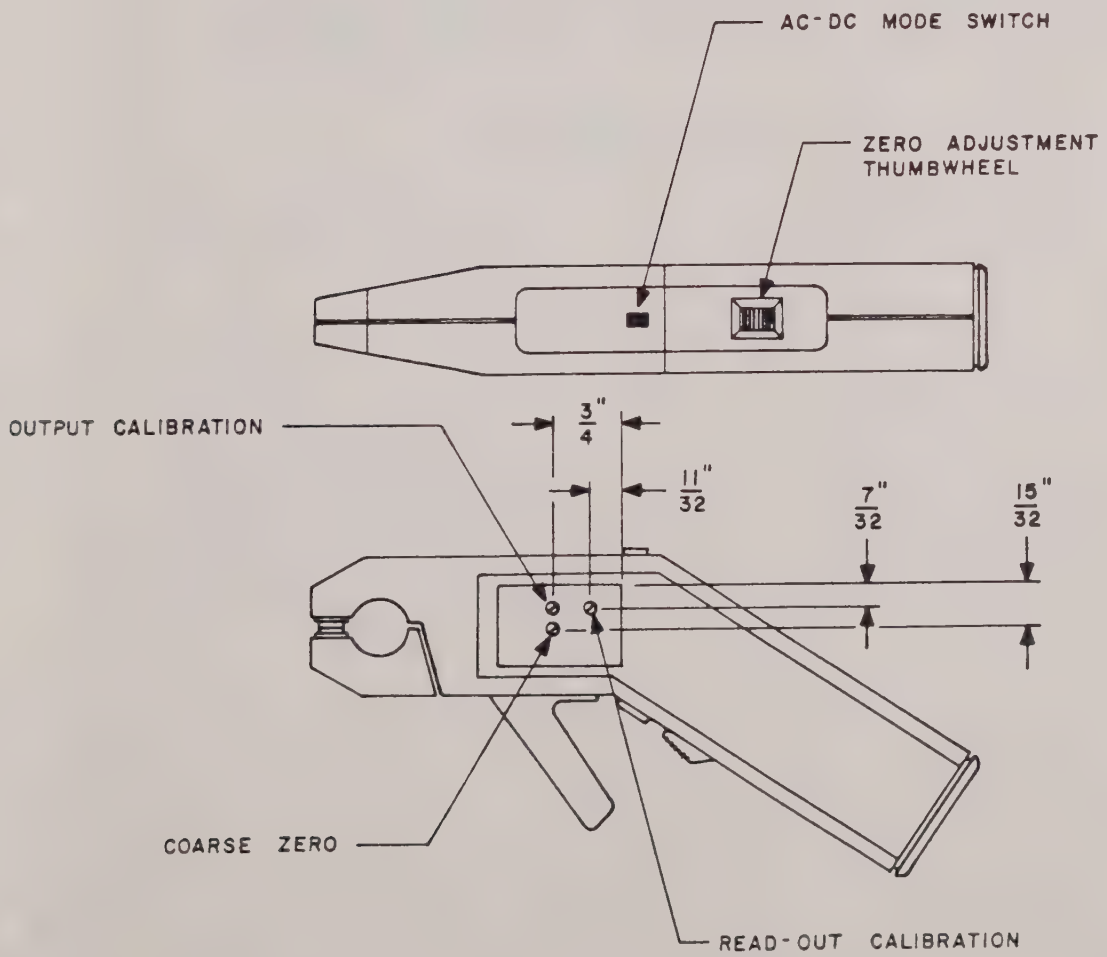



FIGURE 3, TRIM ADJUSTMENT LOCATIONS

IV. TROUBLSHOOTING:

A. Before referencing the following troubleshooting guide for the Gun, check the obvious potential source of problems such as the ON/OFF switch, power source (batteries), and loose or incorrect connections to the Gun and peripheral equipment.

B. The following troubleshooting guide is keyed to the schematics or wiring diagrams contained in this manual. The troubleshooting guide is presented by test and symptom with the related possible cause.

IF IT IS DETERMINED THAT THE CORE, COIL, OR SENSOR IS DEFECTIVE, RETURN THE PROBE TO THE MANUFACTURER. THESE PARTS ARE NOT FIELD REPLACEMENT PARTS.

TROUBLESHOOTING GUIDE

| TEST AND SYMPTOM | POSSIBLE CAUSE |
|---|---|
| 1. INITIAL | |
| Low battery indicator is on when unit is turned on. | Low batteries, Q101, IC-102. |
| No output or meter reading low battery indicator off. | Dead batteries, Q2, CR3, C4. |
| Unit will not turn off. | S3, IC3, Q2, CR5. |
| Batteries discharging rapidly. | S2, C3. |

## TROUBLESHOOTING GUIDE (CONTINUED)

| TEST AND SYMPTOM | POSSIBLE CAUSE |
|---|---|
| 2. OUTPUT/METER TESTS (No Input Current) | |
| Cannot vary output with thumb zero knob. | No Hall Generator control current. Check voltage across R17 (=0.30Vdc), if not check IC1, CR7, Q1.<br>*Open HG-1 (Should be 40Ω to 120Ω) measured from red to black leads of HG-1. |
| dc output and meter reading continues to drift after unit is turned on. | *Defective HG-1. |
| Output OK, meter drifts. | S1, IC-101, R103. |
| Cannot zero output with thumb zero knob. | Coarse Zero out of Cal, IC1, HG-1. |
| Output > ±3.0Vdc, meter is overranged and cannot adjust with thumb zero or coarse zero. | IC1, HG1** |
| Meter is overranged but output is OK. | IC-101, S1, R103. |
| Meter reading erratic, faint or missing LCD segments. | DS1, connections between LCD and PCB power. |

## TROUBLESHOOTING GUIDE (CONTINUED)

| TEST AND SYMPTOM | POSSIBLE CAUSE |
|---|---|
| Excessive noise @ output. Should be < 2.0mVac. | IC1, C7, HG-1** |
| dc readings OK but ac incorrect. | S1, C2, CR1, IC1. |
| **HOLD CIRCUIT TESTS** | |
| Meter held at one reading and output is OK. | CR4, IC3. |
| Meter reading is not held for approximately 5 seconds. | C4, IC3, CR5, CR3. |
| **CORE DEMAGNETIZING TEST** | |
| Turning unit on and off does not remove the dc residual in the core. (Typical < 0.2A) | S2, C3, L1. |
| **FREQUENCY TEST** | |
| Output and meter reading correct at 60Hz but out of tolerance at 1kHz. | C1 open, core damaged. |

* - If the Hall Generator is open, shorting the red and black leads (points P20 and P23 at the printed circuit board) will cause the correct voltage reading across R17 (= 0.30Vdc).

** - If the Hall Generator is defective, shorting the yellow and blue leads (points P21 and P22 at the printed circuit board), will cause a zero output to be obtained by adjustment of the thumb or coarse zero controls. The noise level on the output will decrease to <3.0mVac.

## V. PARTS LIST:

A. This section contains a parts list and information on how to obtain parts. The parts list describes the part, gives the part or stock number and recommended quantity.

B. HOW TO OBTAIN PARTS:

1. Parts may be ordered from the factory or authorized representatives. For prompt and efficient handling of your order, include the following information:

   a. Quantity
   b. Part or Stock No.
   c. Description
   d. Reference designation
   e. Unit Model No.

TABLE 1 ANALOG PCB ASSEMBLY

| REF | DESCRIPTION | PART OR STOCK NO. | TOT QTY | REC QTY | NOTE |
|---|---|---|---|---|---|
| A1 | ANALOG & POWER PCB ASSEMBLY, FIGURE 4 | ONLY REPLACEABLE PARTS | REF | | |
| C1 | CAP, MONO CER, 0.0047µf | 25530 | 1 | 1 | |
| C2 | CAP, ELECT, 10µf @ 16V | 23262 | 1 | 1 | |
| C3 | CAP, ELECT, 4.7µf @ 16V | 23260 | 1 | 1 | |
| C4 | CAP, TAN, 0.68µf @ 35V | 25690 | 1 | 1 | |
| C5 | CAP, CER, 270Pf | 25182 | 1 | 1 | |
| C6 | CAP, ELECT, 22µf @ 10V | 23065 | 1 | 1 | |
| C7 | CAP, TAN, 56µf @ 6V | 25640 | 1 | 1 | |
| CR1 | DIODE, IN914 | 28015 | 4 | 2 | |
| CR2 | DIODE, IN914 | 20815 | REF | | |
| CR3 | DIODE, IN914 | 20815 | REF | | |
| CR4 | DIODE, IN914 | 20815 | REF | | |
| CR5 | DIODE, IN270 GERMANIUM | 27990 | 2 | 2 | |
| CR6 | DIODE, IN270 GERMANIUM | 27990 | REF | | |
| CR7 | DIODE, CONSTANT CURRENT | 29600 | 1 | 1 | |
| HG1 | CORE ASSEMBLY (NOT SHOWN) | FOOTNOTE "A" | | | A |
| L1 | | | | | |

A IF THE CORE, COIL, OR HALL GENERATOR IS DAMAGED OR FAILS, RETURN TO THE FACTORY OR AUTHORIZED SERVICE CENTER. THESE ARE NOT FIELD REPLACEABLE PARTS.

TABLE 1 ANALOG PCB ASSEMBLY (CONT.)

| REF | DESCRIPTION | PART OR STOCK NO. | TOT QTY | REC QTY | NOTE |
|---|---|---|---|---|---|
| IC1 | IC, QUAD OP-AMP LM-324 | 30020 | 1 | 1 | |
| IC2 | IC, HEX INTR "CMOS" 4069B | 30080 | 1 | 1 | |
| IC3 | IC, QUAD ANALOG SW "CMOS" 4016 | 30075 | 1 | 1 | |
| Q1 | TRANSISTOR, 2N4126 | 29080 | 2 | 1 | |
| Q2 | TRANSISTOR, 2N4126 | 29080 | REF | | |
| R1 | RES, MTL. FILM, 5.11K, 1%, 1/8W | 15112 | 2 | | |
| R2 | RES, MTL. FILM, 5.11K, 1%, 1/8W | 15112 | REF | | |
| R3 | RES, MTL. FILM, 165K , 1%, 1/8W | 15129 | 2 | | |
| R4 | RES, MTL. FILM, 165K , 1%, 1/8W | 15129 | REF | | |
| R5 | RES, CER. (POT) 50KΩ , COARSE ZERO | 22055 | 1 | 1 | |
| R6 | RES, CARBON FILM, 2.2K, 5%, 1/4W | 11541 | 2 | | |
| R7 | RES, CARBON FILM, 2.2K, 5%, 1/4W | 11541 | REF | | |
| R8 | RES, PANEL MTU. (POT) 200Ω | 21300 | 1 | 1 | |
| R9 | RES, MTL. FILM, 100K, 1%, 1/8W | 15130 | 1 | | |
| R10 | RES, MTL. FILM, 97.6K, 1%, 1/8W | 15145 | 1 | | |
| R11 | RES, MTL. FILM, 6.49K, 1%, 1/8W | 15131 | 2 | | |
| R12 | RES, MTL. FILM, 6.49K, 1%, 1/8W | 15131 | REF | | |
| R13 | RES, MTL. FILM, 11.8K, 1%, 1/8W | 15156 | 1 | | |
| R14 | RES, CER. (POT), 2KΩ CAL. | 22059 | 1 | 1 | |

TABLE 1 ANALOG PCB ASSEMBLY (CONT.)

TABLE 1 ANALOG PCB ASSEMBLY (CONT.)

| REF | DESCRIPTION | PART OR STOCK NO. | TOT QTY | REC QTY | NOTE |
|---|---|---|---|---|---|
| R15 | RES, CARBON FILM, 5.1K, 5%, 1/4W | 11550 | 1 | | |
| R16 | RES, CARBON FILM, 6.2K, 5%, 1/4W | 11552 | 1 | | |
| R17 | RES, MTL. FILM, 12.1Ω , 1%, 1/8W | 14877 | 1 | | |
| R18 | RES, CARBON FILM, 10M, 5%, 1/4W | 11628 | 1 | | |
| R19 | RES, CARBON FILM, 1M , 5%, 1/4W | 11605 | 2 | | |
| R20 | RES, CARBON FILM, 100K, 5%, 1/4W | 11581 | 1 | | |
| R21 | RES, CARBON FILM, 1K , 5%, 1/4W | 11533 | 1 | | |
| R22 | RES, CARBON FILM, 1M , 5%, 1/4W | 11605 | REF | | |
| R23 | RES, CARBON FILM, 510K, 5%, 1/4W | 11598 | 1 | | |
| S1 | SWITCH, SLIDE DPDT | 33701 | 1 | 1 | |
| S2 | SWITCH, SNAP ACTION | 33860 | 2 | 1 | |
| S3 | SWITCH, SNAP ACTION | 33860 | REF | | |
| SA1 | JACK ASSEMBLY | SUB-ASSY 3011 | 1 | 1 | |
| W1 | JUMPER STRIP, 3 COND. | 52245 | 2 | 1 | |
| W2 | JUMPER STRIP, 3 COND. | 52245 | REF | | |
| MP1 | STAND-OFF, (SWITCH BUSHING) | 41382 | 1 | 1 | |
| MP2 | SCREW 4-40 x 3/4" PPHMS | 45095 | 1 | 1 | |
| MP3 | NUT/LOCKWASHER 4-40 | 46450 | 1 | 1 | |

TABLE 1 ANALOG PCB ASSEMBLY (CONT.)

| REF | DESCRIPTION | PART OR STOCK NO. | TOT QTY | REC QTY | NOTE |
|---|---|---|---|---|---|
| MP4 | BUTTON, SW | 39400 | 1 | 1 | |
| MP5 | SPRING, SW | 47960 | 1 | 1 | |
| MP6 | BLOCK, FOAM | 39705 | 1 | 1 | |
| MP7 | HOLDER, BATTERY | 35710 | 1 | 1 | |

TABLE 1 ANALOG PCB ASSEMBLY (CONT.)

TABLE 2 DIGITAL DISPLAY PCB ASSEMBLY

| REF | DESCRIPTION | PART OR STOCK NO. | TOT QTY | REC QTY | NOTE |
|---|---|---|---|---|---|
| A2 | DIGITAL DISPLAY PCB ASSEMBLY, FIGURE 5 | ONLY REPLACEABLE PARTS | REF | | |
| C101 | CAP, CER. DISC., 180 Pf @ 50V | 25180 | 1 | 1 | |
| C102 | CAP, MYL., 0.1µf @ 100V | 25045 | 2 | 1 | |
| C103 | CAP, MYL., 0.1µf @ 100V | 25045 | REF | | |
| C104 | CAP, MYL., 0.47µf @ 100V | 25055 | 1 | 1 | |
| C105 | CAP, MYL., 0.22µf @ 100V | 25050 | 1 | | |
| DS101 | LIQUID CRYSTAL DISPLAY | 30540 | 1 | 1 | |
| IC-101 | IC, A/D CONV., ICL7116 "CMOS" | 30078 | 1 | 1 | |
| IC-102 | IC, QUAD EXOR., 4030 "CMOS" | 30085 | 1 | 1 | |
| Q101 | TRANSISTOR, 2N4124 | 29070 | 1 | | |
| R101 | RES, CARBON FILM, 20K, 5%, 1/4W | 11564 | | | |
| R102 | RES, CARBON FILM, 390K, 5%, 1/4W | 11595 | | | |
| R103 | RES, TRIM POT, 100K | 21930 | 1 | 1 | |

TABLE 2 DIGITAL DISPLAY PCB ASSEMBLY (CONT.)

| REF | DESCRIPTION | PART OR STOCK NO. | TOT QTY | REC QTY | NOTE |
|---|---|---|---|---|---|
| R104 | RES, CARBON FILM, 100K, 5%, 1/4W | 11581 | 2 | | |
| R105 | RES, CARBON FILM, 1M , 5%, 1/4W | 11605 | 1 | | |
| R106 | RES, CARBON FILM, 300K, 5%, 1/4W | 11592 | 1 | | |
| R107 | RES, CARBON FILM, 100K, 5%, 1/4W | 11581 | 1 | | |
| R108 | RES, MTL. FILM, 100K, 1%, 1/8W | 15130 | 1 | | |
| R109 | RES, MTL. FILM, 14.3K 1%, 1/8W | 15158 | 1 | | |
| W101 | JUMPER STRIP, 13 COND. | 52240 | 2 | 1 | |
| W102 | JUMPER STRIP, 13 COND. | 52240 | REF | | |
| MP101 | FRAME, CONN. | | 1 | 1 | |
| MP102 | CONNECTOR, ZEBRA STRIP | 39399 | 2 | 2 | SET |
| MP103 | CONNECTOR, ZEBRA STRIP | | REF | | |
| MP104 | CLAMP, DISPLAY | 39399 | 2 | 2 | |
| MP105 | CLAMP, DISPLAY | 39399 | REF | | |
| MP106 | SCREW, 3-48 x 1" PPH | 44925 | 4 | 2 | |
| MP107 | SPACER, #4 x 0.625" | 41384 | 4 | 2 | |
| MP108 | BUSHING, NYL. | 48425 | 4 | 2 | |

TABLE 2 DIGITAL DISPLAY PCB ASSEMBLY (CONT.)

TABLE 3 FINAL ASSEMBLY

| REF | DESCRIPTION | PART OR STOCK NO. | TOT QTY | REC QTY | NOTE |
|---|---|---|---|---|---|
| $A_1$ | ANALOG & POWER PCB ASSEMBLY | SUB-ASSY 3033 | 1 | | |
| $A_2$ | DIGITAL DISPLAY PCB ASSEMBLY | SUB-ASSY 3032 | 1 | | |
| B1-B4 | BATTERY, 1.5V, ALK, SIZE AA | 35930 | 4 | | |
| | HARDWARE | | | | |
| | SCREW 4 - 20 x 3/4" | 45140 | 1 | | |
| | SCREW 6 - 19 x 7/8" | 45366 | 1 | | |
| | SCREW 6 - 19 x 1" | 45385 | 1 | | |
| | HINGE PIN | 48250 | 1 | 1 | |
| | SCREW 4 - 24 x 5/16" | 44995 | | | |
| | WASHER, FIBER | 47940 | | | |
| MP109 | LABEL, MODEL/LOGO, QB-1733 | 38925 | 1 | | B C |
| MP110 | LABEL, FUNCTION, QB-1732 | 38926 | 1 | | |
| MP111 | LABEL, BACK COVER, QB-1729 | 38923 | 1 | 1 | |
| MP112 | BACK COVER | ~~28623~~ 37412 | 1 | 1 | |

TABLE 3 FINAL ASSEMBLY

TABLE 3 FINAL ASSEMBLY (CONT.)

| REF | DESCRIPTION | PART OR STOCK NO. | TOT QTY | REC QTY | NOTE |
|---|---|---|---|---|---|
| MP113 | BUTTON, LOCK (ON-OFF) | 39401 | 1 | 1 | |
| MP114 | KNOB, POT (TO, R8) | 39403 | 1 | 1 | |
| MP115 | SPRING, JAW | 47961 | 1 | 1 | |
| MP116 | LENS, CLEAR | 37122 | 1 | 1 | |
| B | THE MODEL/LOG LABEL TAKEN OFF AND REPLACED WHEN THE UNIT IS CALIBRATED. | | | | |
| C | THE FUNCTION LABEL MUST BE REPLACED IF THE UNIT IS OPENED. | | | | |

TABLE 3 FINAL ASSEMBLY (CONT.)

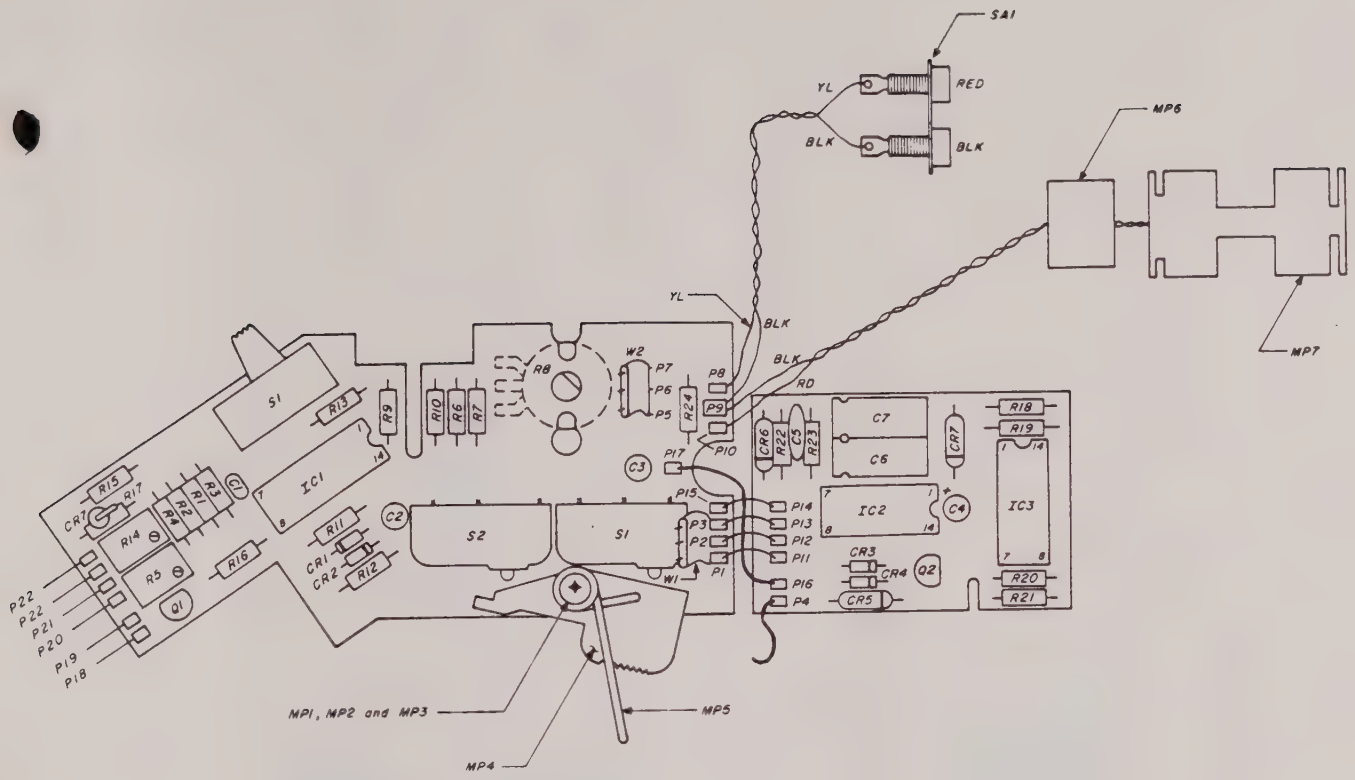



FIGURE 4 A1 ANALOG AND POWER PCB ASSEMBLY

UB-3986

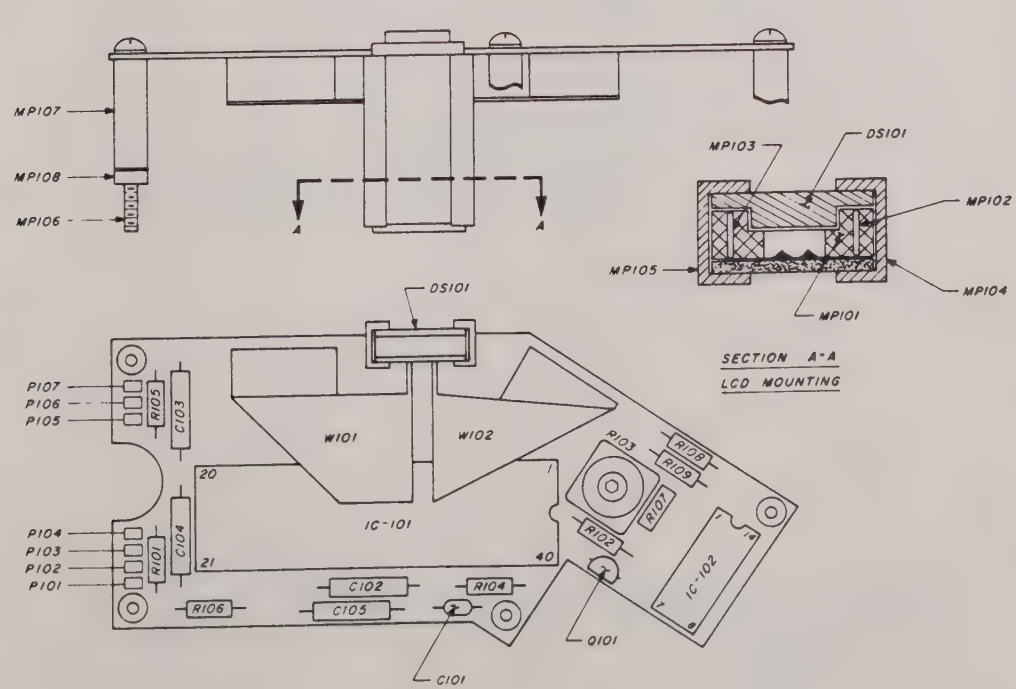
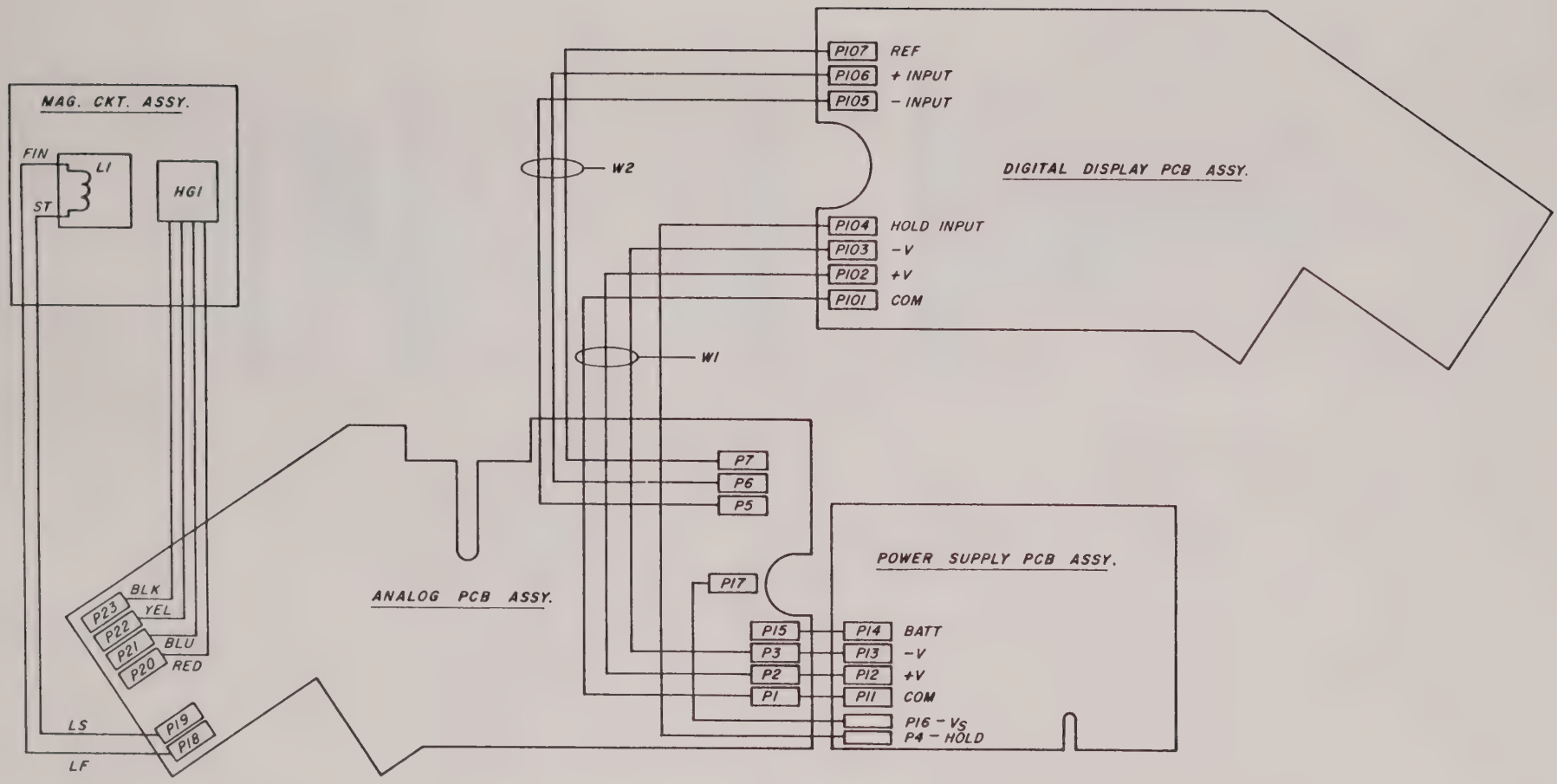


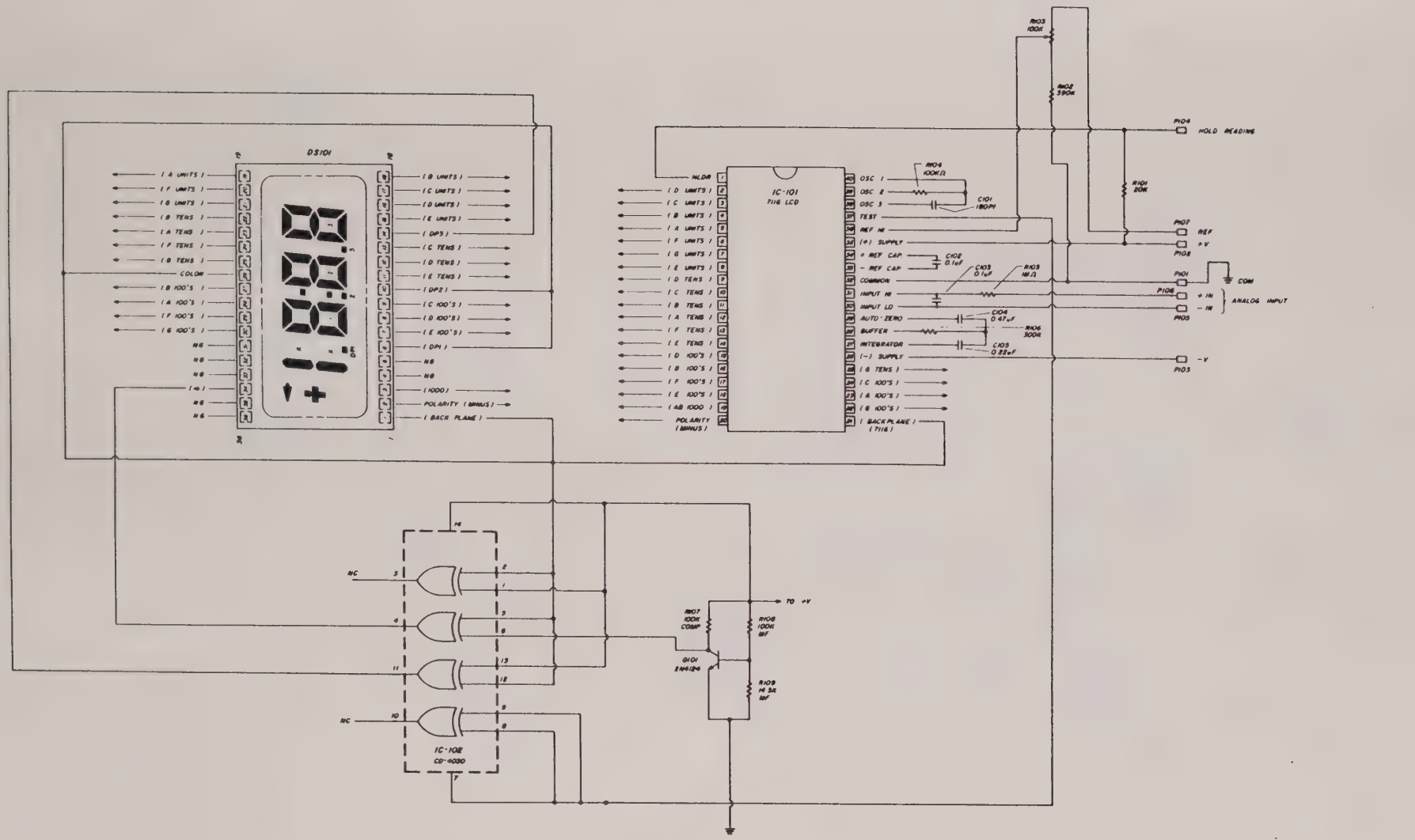

FIGURE 5 A2 DIGITAL DISPLAY PCB ASSEMBLY

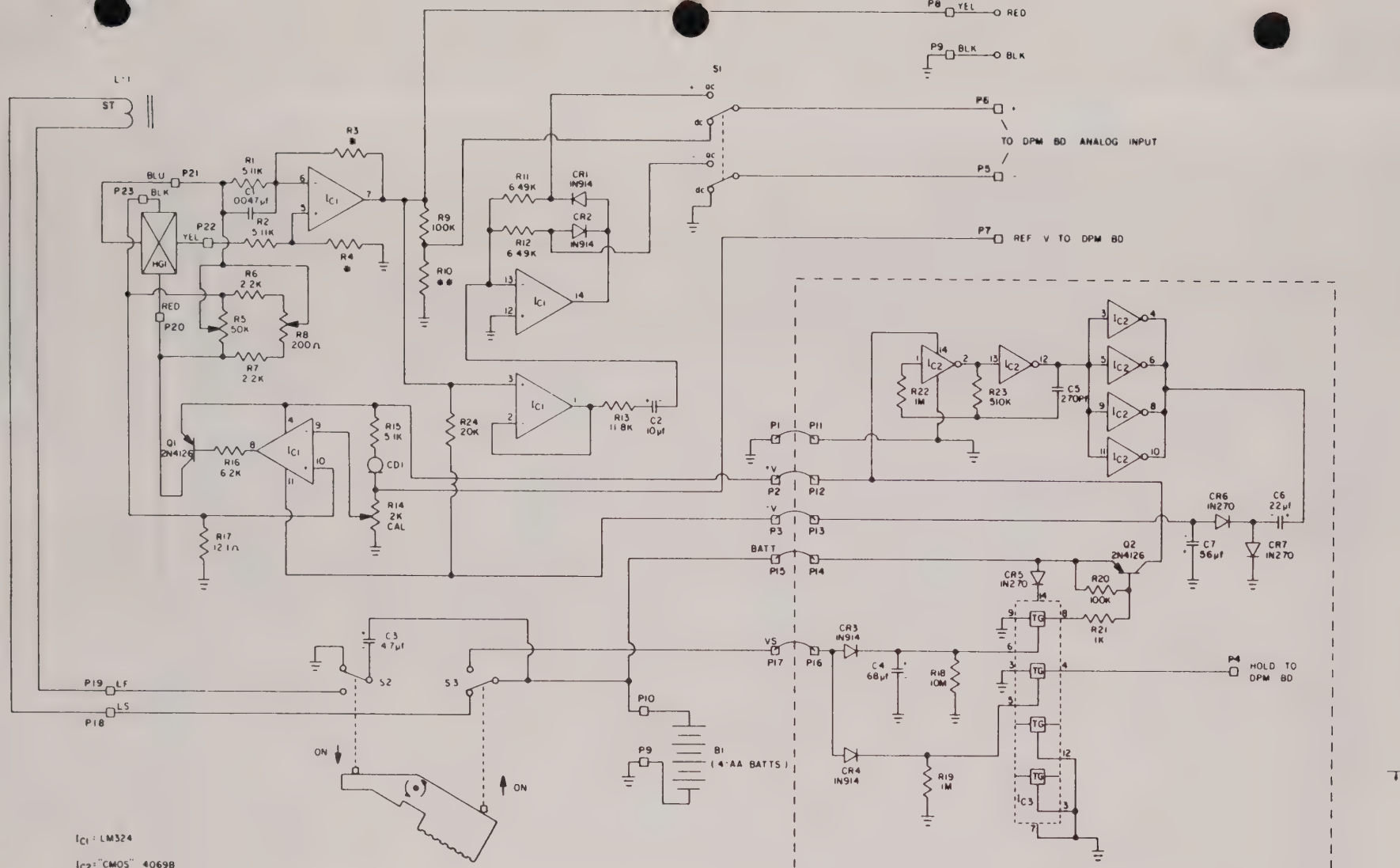
UB-3984




INTERCONNECTION WIRING DIAGRAM, GUN PLUS

UB-3981


DS101
IC-101
7116 LCD
IC-102
CD-4030
R103 100K
R102 390K
R104 100K Ω
C101 180PF
R101 20K
C102 0.1uF
C103 0.1uF
R105 1M Ω
C104 0.47uF
R106 300K
C105 0.22uF
R107 100K COMP
R108 100K 1%F
R109 14.3K 1%F
Q101 2N4124
P104 HOLD READING
P107 REF
P108 + V
P101 COM
P106 + IN
P105 - IN
ANALOG INPUT
P103 - V
TO +V
DIGITAL PCB
UD-3723
A




$I_{C1}$ = LM324

$I_{C2}$ = "CMOS" 4069B

$I_{C3}$ = "CMOS" 4016

* R3 and R4 = 165K

** R10 = 97.6K TO 100KΩ, FACTORY SELECTED

SCHEMATIC, ANALOG PCB

GUN PLUS MODEL CG-100D

| DWG NO | REV |
|---|---|
| UC-3717 | A |

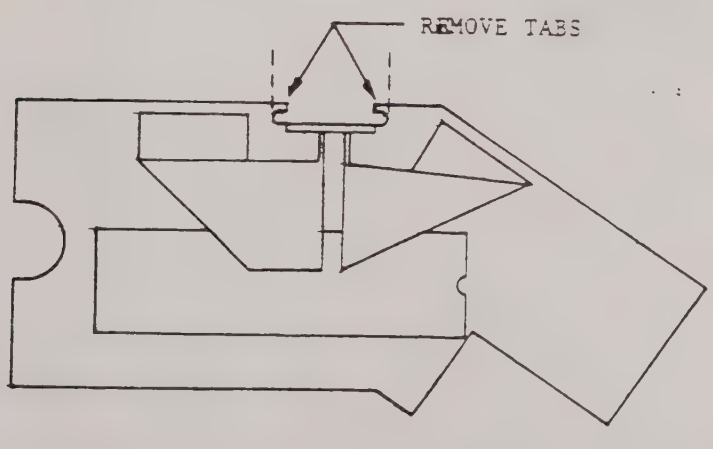
| LTR | ECO | DESCRIPTION | BY / DATE | APR |
|---|---|---|---|---|
| A | 4790 | SEE E.C.O. | 11-14-84 CM | |

NOTE:

This instruction applies to all "GUNS" using LCD displays except model PG-200D with display printed circuit boards prior to revision B.

1. Parts are required as listed in reference (1) thru (3).
2. Remove or displace top PCB to gain access to the display.
3. Remove "Black" LCD side clamps from the display assembly.
4. Remove LCD, frame and elastomers (Zebra Strips) from the display PCB.
5. If the PCB assembly has small tabs, as shown in Fig. I, remove the tabs (cut off) to the area shown by dashed lines.

FIG. I




| REF | QTY | DRAWING NO. | DESCRIPTION |
|---|---|---|---|
| 3 | 1 | 30545 | Display, Liquid Crystal QB-1761 |
| 2 | 2 | 31250 | Zebra Strip, XA-0455 |
| 1 | 1 | 39411 | Frame, PB-2357 |

MATERIAL & FINISH

SCALE

TOL ±

MFG ±

DRN 28, Aug. 84 CRM

CKD 29 AUG 84

APR 29 Aug 84

REL 30 AUG 84 JRH

ORLANDO, FLORIDA BELL INC

TITLE

"GUN" LCD
REPLACEMENT INSTRUCTIONS

SHT 1 OF 2

DWG NO. UA-4252

REV. A

ISSUE

6. Install new LCD assembly as follows. (See Fig. II)

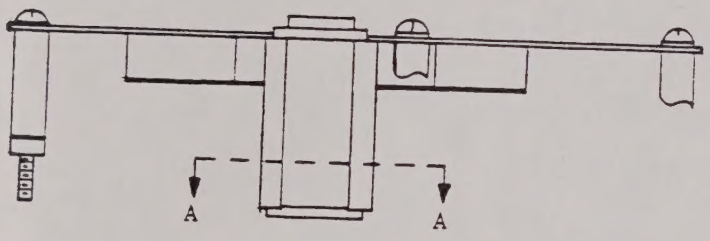
   A. Place new frame (1) into alignment holes on display PCB.

   B. Place new Zebra (elastomer) Strips (2) into slots of frame.

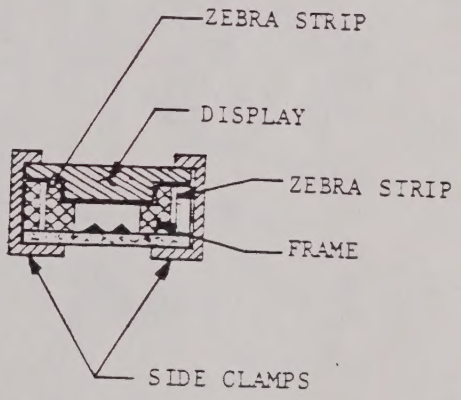
   C. Properly orient and install new LCD (3) into the frame.

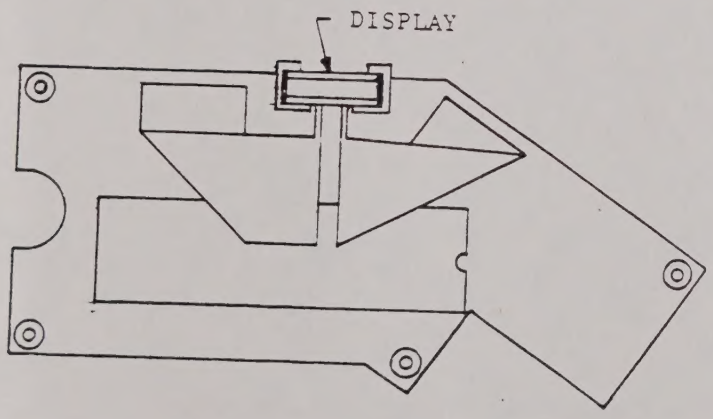
   D. Re-install "Black" LCD side clamps to display PCB assembly.

FIG. II




SECTION A-A
LCD MOUNTING



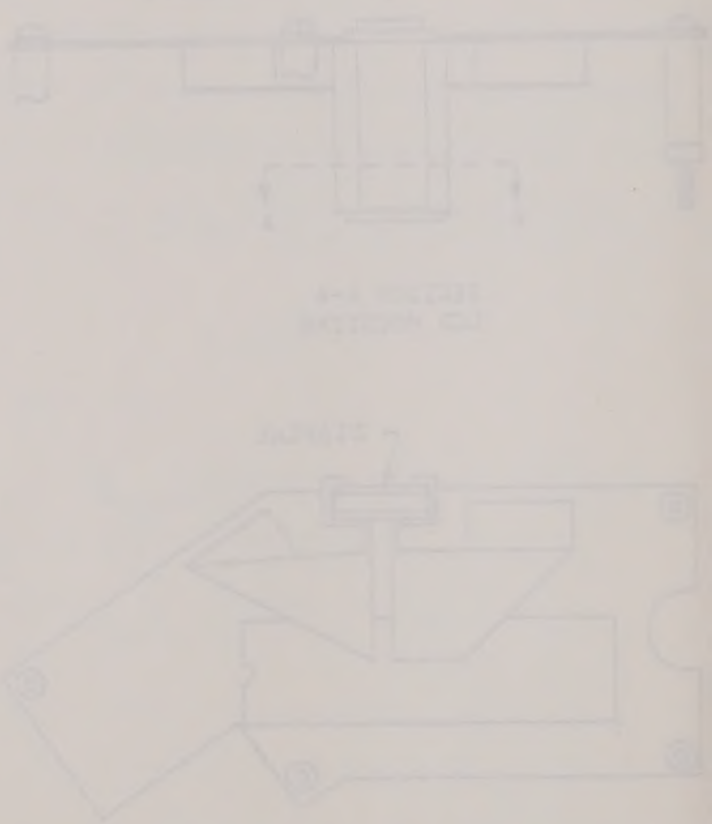




7. Re-install top PCB in proper position in gun.

NOTES: 1. If the new assembly will not slip into the opening in the bottom PCB, remove side edge material as required.

"DO NOT CUT INTO CLAD"

2. Diagonal cutters may be used to cut the PCB material.



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